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ABSTRACT

The Pennsylvania industrial arts curriculum guide for grades 7 and 8 reflects changing philosophy and practices in industrial arts education as well as incorporating the effect of technological changes. Objectives unique to industrial arts education are: (1) to develop literacy in a technological civilization, (2) to develop an insight and understanding of industry and its place in society, (3) to discover and develop student talents, (4) to develop problem-solving abilities, and (5) to develop skill in safe use of tools and machines. The guide includes a content outline for three content areas of industrial arts: (1) visual communications, (2) power, and (3) industrial materials. The visual communications sequence on graphic arts is directed toward extending the student's ability to visually communicate. A power unit focuses on various energy forms, the matter from which they are derived, and conversion of energy forms into useful work. An industrial materials content area deals with a study of production and construction materials. Each unit provides second level behavioral objectives, content outline, a suggested model of instructional activity, and instructional materials. (Author/EA)

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A Suggested Planned Course in Industrial Arts Grades 7 and 8

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Milton J. Shapp, Governor

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Donald M. Carroll Jr., Commissioner
Harry K. Gerlach, Deputy Commissioner

Bureau of Curriculum Services
Michael E. Flanagan, Acting Director

Pennsylvania Department of Education
Box 911
Harrisburg, Pa. 17126

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FOREWORD

In a country where the population is able to witness the landing of people on the moon through pictures, to prepare food by the use of ultrasonic waves and to have the quantity of technical information tripled each decade--neglecting to teach our youth about the importance of industrial technical advances will have an adverse effect upon future socioeconomics in our nation. Industrial arts is that subject area which is involved in providing the youth with knowledge about the technological environment related to industry of the past, present and future.

This *Suggested Planned Course in Industrial Arts* is designed in order that the students will be acquainted with environmental, consumer and occupational knowledges in a variety of industrial areas. An inter-disciplinary approach should be utilized to bring about the understanding of this technological information; correlation with mathematics, sciences, social studies, fine arts and language arts is of primary importance for successful accomplishment of our goals. Innovative approaches to organizational and instructional patterns are encouraged on the part of the instructor in order to accommodate the expected and changing educational requirements of youth.

PURPOSE OF THE SUGGESTED PLANNED COURSE

The purpose of this guide is to assist the industrial arts teacher in the development of a planned course that reflects the changing philosophy and practices in industrial arts education as well as incorporating the effect of technological changes. It is hoped that teachers will prepare planned courses to meet the requirements for industrial arts as set forth in the state curriculum regulations for grades seven and eight.

The curriculum regulations adopted by the State Board of Education in Pennsylvania issued on March 14, 1969, dealing specifically with industrial arts in the junior high school, carries with it all the force of the school laws of Pennsylvania. In Chapter 7, paragraph 7-231, part F is as follows:

7-231 JUNIOR HIGH SCHOOL CURRICULUM–The junior high school curriculum shall include, as a minimum, the following planned courses:

F. *Industrial Arts or Homemaking*–One planned course of both, taught in either grade seven or grade eight or the equivalent divided between grades seven and eight. Industrial arts and homemaking shall be a required offering in grade nine.

The planned course is defined in paragraph 7-123 as follows:

A. *Planned Course*–A planned course shall consist of at least:
   1. A written statement of objectives to be achieved by students.
   2. Content to be used to reach objectives for which credit is awarded at the junior high and senior high levels.
   3. Expected levels of achievement.
   4. Procedures for evaluation.

In meeting these regulations it is believed that all industrial arts teachers will wish to have a guide with examples for instructional reference. This suggested planned course was written by the Division of Industrial Arts, Bureau of Curriculum Services Education, Pennsylvania Department of Education in cooperation with the curriculum committee of the Industrial Arts Association of Pennsylvania composed of classroom teachers, teacher educators and supervisors.

Classroom teachers are encouraged to use professional initiative in writing a planned course that will meet the needs of their local school district and identify objectives in a behavioral manner. The course and objectives should be in harmony with the philosophy and content as presented in this guide.

Today's content for industrial arts is derived from a broad based technological cluster, rather than being centered in the areas of wood, metal and drawing. The present content areas are clustered about the fields of industrial materials, power and visual communications. Planning for a balanced program in industrial arts should allow a maximum number of hours of instruction in each of the instructional areas. Industrial arts teachers are encouraged to make use of all the new multi-media methods of instruction which have been introduced and developed in recent years. The success of any industrial arts program can be reflected in the incorporation of new technology and teaching methodologies.

OBJECTIVES OF THE SUGGESTED PLANNED COURSE

Through carefully planned and guided experiences, education should provide opportunities for students to develop into active, contributing members of society. At each school level the educational program should be fitted to meet the needs, interests and abilities of the pupils being served.

Industrial arts makes certain unique contributions to the total program of education and enriches the content of other instructional areas as well.

Industrial arts is designed specifically to help individuals to understand a technological culture. As an integral part of the total program of education, indsutrial arts provides unique opportunities for pupils to gain experience in industrial skills and processes. The Commonwealth of Pennsylvania has adopted the following basic objectives.

OBJECTIVES OF INDUSTRIAL ARTS

To provide a sound program of industrial arts, clear and realistic objectives are essential. The following statements of purpose are unique to industrial arts education:

1. *To develop literacy in a technological civilization.*
   In such a society one must be able to communicate in the language of industry, technology and science.

2. *To develop an insight and understanding of industry and its place in our society.*
   Since industry is a constructive, dynamic force in the world today, it is the responsibility of the school to provide opportunities for each student to understand this force. Industrial arts provides significant learning activities in which students acquire knowledge and skill in performance through study and application.

3. *To discover and develop student talents.*
   The school's responsibility is to assist students in discovering and developing their talents. It is the responsibility of industrial arts education to identify special abilities through manipulative and research experiences.

4. *To develop problem-solving abilities related to a variety of tools, materials, processes and products.*
   The problem-solving approach in industrial arts involves creative thinking, and gives the student an opportunity to apply principles of planning and design. Constructive techniques, industrial processes, scientific principles and mathematical computations are applied to the solution of problems.

5. *To develop skill in the safe use of tools and machines.*
   Industrial arts provides planning, construction and production activities which enable students to acquire industrial-technical skills. These activities offer opportunities to develop tool and machine skills commensurate with the mental and physical maturity of the student.

These five objectives may be considered basic for industrial arts as a whole, but supplementary objectives in keeping with local conditions should be developed by individual school districts for the various ages and grades--elementary, junior high school, senior high school and adult

programs. Supplementary objectives should be considered for both the gifted and slow learners within each of the above levels.[1]

For the student to reach the objectives at the end of the planned course the teacher must *"select procedures, content and methods that are relevant to the objectives; cause the student to interact with appropriate subject matter in accordance with principles of learning; and, finally measure or evaluate the student's performance according to the objectives or goals originally selected."*[2]

The curriculum areas of industrial arts from which the planned course is derived are industrial materials, visual communications and power. To reflect this age of technology and implement the stated objectives, industrial arts curriculum development in Pennsylvania is being projected from these three technical areas. The content will change to reflect the emerging trends of indsutry and technology, but the three technical areas will remain as an identifiable structure upon which industrial arts is derived.

The curriculum content of these three technical areas must be developed in terms of behavioral objectives. A behavioral objective is a statement communicating a teacher's intentions by denoting behavior which students must demonstrate when they have successfully completed a learning experience. The statement should have sufficient detail so others will interpret the statement the same way.

The technical area objectives will be stated in the following sections of this planned course guidelines. Examples of specific instructional objectives will be given, but the teacher is expected to write most of the objectives in terms of a planned course.

Further help in writing the third level behavioral objectives can be found in Robert F. Mager's book, *Preparing Instructional Objectives* published by Fearon Publishers, Palo Alto, California 94306, and *Behavioral Objectives in Curriculum and Evaluation* published by Kendall, Hunt, Dubuque, Iowa 52001.

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[1] Industrial Arts Philosophy and Objectives, Department of Public Instruction, Commonwealth of Pennsylvania, Harrisburg, 1964.

[2] Robert F. Mager, Preparing Instructional Objectives, California: Fearon Publishers, 1962.

Visual Communications

VISUAL COMMUNICATIONS

The visual communications sequence of the suggested planned program is designed to acquaint students with technology that has been developed to assist them in visually communicating attitudes, ideas and information from one person to another.

This sequence does not attempt to develop highly specialized skills, but it attempts to develop the students understanding of how they can extend their ability to visually communicate.

SECOND LEVEL OBJECTIVES FOR VISUAL COMMUNICATIONS

The students will be able to:

1. Correctly define four basic reproduction processes orally or produce a simple sketch to illustrate each process.
2. Sketch an orthographic projection from an isometric drawing or an object.
3. Diffenentiate a negative from a positive film.
4. Properly expose, develop and print photographic film.
5. Identify and describe the differences between two basic bindery techniques.
6. Describe the differences between four finishing techniques.
7. Correctly describe three methods of reproducing mechanical drawings.
8. Correctly name two different ways of storing drawings.
9. Name four ways that society has benefitted by visual communications.
10. Name four ways that society has been negatively influenced by visual communications.
11. Differentiate a half tone from a line copy.

CONTENT OUTLINE FOR VISUAL COMMUNICATIONS

I. Visual Communications
   - A. Impact of visual communications on:
     1. Commerce
     2. Aesthetics
     3. Daily life
     4. Industry
     5. Education
   - B. Applications of visual communications techniques to:
     1. Instructional
     2. Informational
     3. Reference
     4. Entertainment
     5. Persuasion
   - C. Historical aspects of vusual communications are:
     1. Prehistoric communications
     2. Early use of paper in communication
     3. Impact of the printing
     4. Modern communications method

D. Visual communications complex are:
    1. Allied industries
    2. Related industries

II. Representations of ideas in a graphic form.
  A. Size description
    1. Signs
    2. Symbols
    3. Use of alphabets
    4. Dimensions
      (a) space
      (b) time
      (c) motion
  B. Shape description
    1. Pictorials
      (a) oblique
      (b) axonometric
      (c) perspectives
    2. Rendering
    3. Orthographic
  C. Layout
    1. Copy analysis
    2. Copy fitting
    3. Scaling
    4. Dummying
    5. Original art
    6. Thumbnail (rough) sketches
    7. Typography
    8. Comprehensive
  D. Design
    1. Elements
    2. Principles
      (a) formal arrangements
      (b) informal arrangements

III. Reproduction of graphic materials.
  A. Assembly of elements into an image carrier
    1. Compostion
      (a) hot metal
        (1) hand
        (2) machine
      (b) cold type
        (1) photo-typesetting
        (2) strike-on
        (3) transfer

(c) autographic techniques
(1) hand cut stencils
(2) relief cuts
(3) lithography
(4) dry-point engraving

2. Conversion processes
(a) photographic
(1) continuous tone
(2) line
(3) halftone
(b) electronics (television)

3. Imposition
(a) stripping flats
(b) adhering stencils
(c) platemaking
(d) flexography (rubber stamps)

B. Transport by the carrier to paper or other materials
1. Letterpress printing
2. Offset printing
3. Gravure printing
4. Stencil printing
5. Drafting reproduction processes
(a) micro-film
(b) white prints
(c) blue prints
6. Duplicators
7. Copiers
(a) thermal
(b) electrostatic
(c) photographic

IV. Presentation and/or dissemination of graphic materials.
A. Finishing
1. Thermography
2. Embossing
3. Die-cutting
4. Scoring
5. Perforating
6. Folding
7. Collating and gathering

B. Bindery
1. Padding
2. Case

3. Perfect
4. Mechanical

C. Mounting

D. Packaging

E. Marketing
1. Research
2. Advertising
3. Shipping
4. Distribution
5. Sales

Please NOTE: It is impossible to limit an outline of content because each teacher, facility, school and community is different. Therefore, it was not the intent of the committee that a teacher should try to implement this outline in its entirety but to derive from it those areas that best meet the needs of students.

SUGGESTED MODEL OF INSTRUCTIONAL ACTIVITY FOR VISUAL COMMUNICATIONS

The following material is merely an example. Each teacher is encouraged to develop an instructional activity to meet the needs of students. This model can be treated as a group activity or an individual activity. Both have to be accounted for when writing a course of study.

I. Visual communications unit on producing a school magazine.

A. Behavioral objectives (this is one example of how a third level objective may be written) Each student:
1. Provided with a list of basic operations in producing the magazine will be able to organize a sequential time line of these operations.
2. Provided with the necessary elements and graphic signs will be able to prepare a final layout in accordance with the selected reproduction system.
3. Will be able to list and describe four basic methods of reproducing printed materials.
4. Will be able to define artistic and technical drawing.
5. Given a piece of paper, a pencil and an eraser will be able to communicate a given idea through the medium of freehand sketching.
6. Provided with a list of principle occupations will be able to identify those related to the visual communications industries.
7. Will be able to list four applications of visual communications techniques.

B. Content outline
1. History of society and visual communications
2. Organization of production activities for publishing a magazine
a. selection of general theme
b. developing and editing material for inclusion in a magazine
c. selection of art work and accompanying captions
d. general page layout and final copy preparation
e. duplication of complete page layouts
f. collation and binding of duplicated pages of a magazine
g. dissemination of finished magazine

C. Activities

1. Students working as a class will design, organize, produce and disseminate a school magazine.
2. Students will visit a local industry involved in various aspects of visual communications.

D. Audio-visual materials

1. *"Graphic Arts Transparencies"*, DCA Educational Products, 4865 Stenton Avenue, Philadelphia, Pennsylvania 19144.
2. *"Aids for Teaching Visual Communications"*, Division of Consumer Market, Eastman Kodak Company, Rochester, New York 14650.

E. Publications

1. Books
   a. Carlsen, Darvey E. *Graphic Arts.* Peoria, Illinois: Chas. A. Bennett Co., 1958.
   b. Kagy, Fredrick D. *Graphic Arts.* Chicago, Illinois: Goodheart-Willcox Co., 1961.
   c. Cataldo, John W. *Graphic Design and Visual Communication.* Scranton, Pennsylvania: International Textbook Co., 1968.
   d. Marinaccio, Anthony. *Exploring the Graphic Arts.* Princeton, New Jersey: Van Nostrand Co., 1959.
   e. Bedell, Earl L. *Careers in Graphic Reproduction.* Princeton, New Jersey: Van Nostrand Co., 1965.
2. Periodicals
   a. Schwalm, Ray A. "Visual Communications Education", *Visual Communications Instructor.* Number 4 (October, 1966), 10-13.
   b. Greenwald, Martin. "Junior High Production of the School Yearbook", *School Shop XXIX,* (November, 1969), 47-48.
   c. Thomas, Charles L. "The Disposition of Printing Production", *IAVE* 58, (February, 1969), 27-30.
   d. "Planning Educational Laboratories for Visual Communication Technology", *Kodak Newsletter for Graphic Arts and Photography* Instructors, 2 (June, 1969), 4.

Power

POWER

Power, as a content area of industrial arts, concerns itself with various energy forms, the matter from which they are derived, and the conversion of these energy forms into useful work. Consistent and experience-centered laboratory operations should be designed to clarify the function and application of all types of energy devices.

The following objectives are intended to be useful in suggesting general policy for curriculum development in grades seven and eight.

SECOND LEVEL OBJECTIVES FOR POWER

The students will be able to:

1. Describe various energy sources.
2. Discuss the historical development of energy sources.
3. Compare the various methods of converting energy source into useful work.
4. Differentiate between work and power as they relate to various applications.
5. Identify conservation practices related to the use of energy.
6. Identify pollution hazards and their control in relation to energy sources and their application.
7. Describe the various methods of power generation, transmission and control.
8. Operate and control generating, transmitting and converting equipment and their basic systems.
9. Safely use tools, machines, test and measure equipment related to power technology.
10. Demonstrate consumer competencies in the selection, use and care of various power related products.
11. Construct and assemble represented power devices.
12. Recognize and resolve problems related to power devices.
13. Identify their interests, abilities, career opportunities and leisure time activities available.
14. Apply knowledge in the field of mathematics, science, language arts and social science to the field of power technology.

POWER CONTENT OUTLINE

I. Energy sources - where does energy come from?

- A. Muscle
- B. Wind
- C. Water
- D. Fossil fuels*
- E. Heat*
- F. Light*
- G. Sound
- H. Friction
- I. Magnetism*
- J. Piezoelectric effect
- K. Chemical*
- L. Nuclear

*At least one activity in each of these areas should be completed by every student as a minimum course requirement.

II. Conversion devices - how is energy harnessed?

- A. Windmill
- B. Sail
- C. Batteries*
- D. Thermocouples*
- E. Fuel cell
- F. Solar cell*
- G. Electric motors*
- H. Generators*
- I. Reciprocating engines
  1. Free piston
  2. Two-stroke cycle - gasoline and diesel*
  3. Four-Stroke cycle - gasoline, diesel, and L.P.G.*
- J. Solenoids*
- K. Steam engines*
- L. Reaction engines*
  1. Jets
  2. Rockets
- M. Rotary engines
  1. Turbines
  2. Wankel

III. Transmission methods - how is energy put to work?

- A. Mechanical
  1. Mechanical linkage
  2. Pulleys and cables
  3. Gears*
- B. Electrical
  1. High voltage circuits
  2. Low voltage circuits*
  3. Controls*
- C. Hydraulic-Pneumatic
  1. Pumps*
  2. Servos*
  3. Motors
  4. Controls

IV. Power application.

- A. Industrial
  1. Manufacturing
  2. Construction
  3. Service industries
  4. Research & development
- B. Transportation vehicles on land
  1. Automotive
  2. Trucks
  3. Trains
  4. Recreational
- C. Aerospace
  1. Aviation
  2. Space
- D. Hydrodynamic vehicles
  1. Undersea
  2. Ships
  3. Grounds affect machines on water
  4. Recreational

*At least one activity in each of these areas should be completed by every student as a minimum course requirement.

V. Environmental consideration.

A. Control of pollution by exhaust of power devices.

B. Conservation of natural resources.

VI. Career development.

A. Opportunities available in the field of power.

B. Preparation required for the world of work in the power areas.

SUGGESTED MODEL OF ACTIVITY IN POWER

—The following material is merely an example. Teachers are encouraged to develop an instructional activity to meet the needs of their students. This model can be treated as a group activity or an individual activity. Both have to be accounted for when writing a course of study.

I. Power technology unit on power systems.

A power system is one that consists of the complete sequence of events and operations that goes from the source of energy through to the use of that power developed.

A. Behavioral objectives (this is one example of how a third level objective may be written) Students

1. Will be able to list and define the three parts of a power system cycle.
2. Shall select a power syster device to use as the vehicle for their learning experience.
3. Will be able to define the working fluid in which the energy change takes place in the device selected.
4. Provided with background information will be able to disassemble and assemble all subsystems used on the device selected.
5. Will operate the device and evaluate the output in dynamic analysis in terms of power rating, torque and efficiency.
6. Will be able to list four or more applications of the power system.
7. Provided with a list of principle occupations will be able to identify those related to the power industry.

B. Content outline

1. Historical development of man and power technology.
2. Science related to energy sources in power systems.
3. Working fluid in power system.
4. Power devices used in power system.
5. Power transmission and control of power system.
6. Application and/or use of power system.

C. Activities

1. Students will select a power system individually or as a small group for investigation.
2. Students will visit a local industry involved in the aspect of the power system selected.

D. Audio-visual materials

1. Power Mechanics Set of Transparencies, Delmar Publishers, Inc, Albany, New York 12205.

2. Power Transparencies, D. C. A. Educational Products, Inc., 4865 Stenton Avenue, Philadelphia, Pennsylvania 19144.
3. Combustion Engine Transparencies, 3M Business Product Sales, Inc. 2101 Front Street, North P.O. Box 5037, Harrisburg, Pennsylvania 17110.

E. Publications:

1. Atteberry, Pat H., *Power Mechanics*, Goodheart-Willcox Co., Inc., Chicago, Illinois, 1961.
2. Bohn, Ralph C. and McDonald, Angus S., *Power: Mechanics of Energy Control*, McKnight & McKnight Publishing Co., Bloomington, Illinois, 1970.
3. Buck Engineering Co., *Exploratory Electronics*, Buck Engineering Co., Inc., Farmingdale, New Jersey, 1970.
4. Duffy, Joseph W., *Power Prime Mover of Technology*, McKnight & McKnight Publishing Co., Bloomington, Illinois, 1964.
5. Electronic Aids Inc., *Concepts of Electricity*, Electronic Aids, Inc., Baltimore, Maryland, 1969.
6. Ford, Walter B., *Adventure With Electronics*, The Brace Publishing Co., Milwaukee, Wisconsin, 1968.
7. Glenn, Harold T., *Exploring Power Mechanics*, Charles A. Bennett Co., Inc., Peoria, Illinois, 1967.
8. Lease, Alfred A., *Basic Electronics*, The Brace Publishing Co., Milwaukee, Wisconsin, 1965.
9. Loper, Orla E. and Ahr, Arthur, *Introduction to Electricity and Electronics*, Delmar Publishers, Inc., Albany, New York, 1968.
10. Lush, Clifford K. and Engle, Glenn E., *Industrial Arts Electricity*, Charles A. Bennett Co., Inc., Peoria, Illinois, 1965.
11. Miller, Rex and Culpepper, Fred W., *Experience with Electrons.*
12. Pipe, Ted, *Small Gasoline Engines Training Manual*, Howard W. Sams & Co., Inc., The Bubbs-Merrill Co., Inc., New York, New York.
13. Stephenson, George E., *Power Technology*, Delmar Publishers, Inc., Albany, New York, 1968.
14. Worthington, Robert M.; Margules, Morton? Crouse, William H., *General Power Mechanics*, McGraw-Hill Book Company, New York, New York 1968.

Industrial Materials

INDUSTRIAL MATERIALS

Industrial materials as a content area of industrial arts embraces a study of the materials which lend themselves to production and construction, a study of the processes that change these materials and a study of societys creative effort to produce goods by organizing people, materials and processes. The following second level objectives reflect the behavioral outcomes expected to result from activities in industrial arts. The degree to which these are met are dependent upon student attitudes and capabilities, time and facilities available and the effectiveness of the teacher who is expected to further develop third level behavioral objectives based upon the teachers knowledge of the students and the teaching situation.

SECOND LEVEL OBJECTIVES

The students will be able to:

1. Convey and follow technical instructions by using and interpreting proper terminology, drawings and sketches used in the production of material goods.
2. Identify major departmental structures in industrial organizations.
3. Discover interest, abilities and attitudes toward career choices by engaging in experiences in the use of industrial materials.
4. Work both independently and cooperatively while exhibiting socially desirable behavior.
5. Explore, select and develop skills associated with industrial materials for use in leisure time pursuits.
6. Select and utilize the proper tools and equipment and involve a wide range of industrial processes to produce selected consumer goods for particular applications.
7. Exhibit consumer competency in the selection of manufactured and Constructed goods.
8. Recognize and apply desirable learning experiences through problem solving while using interdisciplinary concepts and techniques.
9. Exhibit safe practices in the processing of industrial materials while using a variety of tools, machines and equipment and will relate these safety practices to use in the home, school and community.

CONTENT OUTLINE

The content for industrial materials logically divides into the areas of natural product materials, synthetic materials and production. Although these are treated as individual entities, they may be taught in associated groups as the teacher sees fit. It is hoped, however, that due emphasis will be given each of these important facits of materials processing.

Emphasis should be placed upon understanding terminology and developing basic concepts in each of the above areas. While studying processes, concepts should be developed which cut across all materials which have developed thru a study of metals, plastics, ceramics and other materials. Comparison would be made between mold materials, methods and producing molds, parting agents, conversion of materials from liquid to solid, methods of filling molds, etc. The concept approach will not only provide a systematic and logical method of studying materials, but the learning will be reinforced by involvement with different materials. This concept approach will also provide a modular building block design for further exposure in the upper grades.

I. Product Ma terials (natural and synthetic).

A. Basic materials to be studied

1. Forest products (wood and wood by-products)
2. Metals (ferrous and non-ferrous)
3. Plastics (thermosetting and thermoplastic)
4. Textiles (natural and synthetic)
5. Ceramics (clays, cements, plasters, glass & enamels)
6. Animal products (hair, skin and bone)

B. Basic concepts of these materials

1. Structure and characteristics
   a. physical (examples - hardness, color, texture, density, plasticity, conductivity)
   b. chemical (examples - corrosion resistance, acidity or alkalinity)
2. History and development
   a. inventors and intentions
   b. chronological use of materials
   c. patent system
3. Collection, extraction and synthesis
   a. lumbering, harvesting
   b. mining, concentrating, smelting, refining
   c. alloying and other combinations of material

II. Processes.

A. *Casting*–conversion of materials from solid to liquid to solid into a predetermined shape.
B. *Parting*–separation of materials by shearing, sawing, burning and melting.
C. *Machining*–shaping solid materials by removing surplus materials.
D. *Pressure forming*–shaping materials through the use of pressure.
E. *Joining*–fastening materials via cohesion, adhesion and mechanical linkage.
F. *Treating*–producing a physical or chemical change in materials.
G. *Finishing*–surface treatment of materials.

III. Production.

A. Custom production

1. Product design & development
2. Cost analysis
3. Occupations
4. Safety

B. Mass production

1. Market research
2. Product design & development
3. Prototype construction
4. Cost analysis
5. Tooling for production
6. Material handling
7. Time study
8. Occupations
9. Personnel structure
10. Inspection and quality control
11. Production safety

SUGGESTED MODEL OF AN INSTRUCTIONAL ACTIVITY FOR INDUSTRIAL MATERIALS

Although it is not the purpose of this guide to negate the professional responsibility of the teacher to select methodology and content to meet the individual needs of learners, teachers in the field have indicated a need for an example of specific goals, and methods to achieve such goals, for a program on the 7th or 8th grade level. It should be noted that the subject matter of industrial material technology as previously defined on the content outline includes all levels of instruction and this planned course provides a broad-base, primary-level experience. Therefore, all following examples are suggested for your consideration.

Since a great deal of flexibility is provided the teacher in choosing types of materials and process technology, these can only serve as samples and guides for the development of their own more specific third level objectives.

I. Production of material goods

A. Behavioral objectives examples - industrial materials

Students

1. Will be able to make and read a simple working drawing or sketch.
2. (From working drawings) will be able to produce a model.
3. Given necessary production data will be able to:
   a. Develop a flow chart showing required jobs, processes and flow of materials.
   b. Select from available materials the ones most suited to specific product requirements.
   c. Select from processes of materials forming–such as casting, parting, machining, and pressure forming–the most appropriate of these to meet product requirements.
   d. Use treating processes to condition materials.
   e. Combine components using either or all of the following methods: cohesion, adhesion, mechanical fastening.
   f. Finish the product according to specifications.
4. Will be able to explain two major differences between custom and mass production of goods.
5. Will be able to write in a space provided on a blank flow chart the hierarchy of jobs in a typical manufacturing company.
6. Will be able to define the terms of jigs and fixtures as applied to mass production.
7. Will demonstrate proper and safe methods using various tools and machines to produce consumer goods.

B. Activity

The following model is designed to incorporate both individual and group activities. It will present the learner with experiences in product materials, processing concepts, and peoples involement in production. The example below is only one means of operationalizing the previously stated behavioral objectives and content outline.

1. Mass-production experience - In order to stimulate learner interest the teacher will begin the year with a mass-produced project that has been designed and tested

by the teacher. Jigs and fixtures must be teacher made and materials required should be previously requisitioned. The intent is to provide the learner with a fairly quick, successful, initial experience that will enable him to make a quality product. The product must be simple and generally useful. Some examples are: salt and peper shakers, neon test lamp, name plate, yo-yo, windshield ice scraper, candle holder, etc.

a. This phase of the program is designed to be no more than 25% of the allotted time in industrial materials. At the conclusion of this phase the teacher will provide an overview of the components in mass production by discussing the following topics: tooling for production, material flow, process analysis, organization of labor.

b. Since the key to the success of this activity lies principally in the hands of the teacher, the following recommendations are made for the teacher preparation:

(1) Select object to be made and build a prototype.

(2) Analyze the product to determine necessary operations and production sequence.

(3) Provide necessary operations and production sequence.

(4) Make necessary jigs and fixtures.

(5) Test the production sequence by making the complete product.

c. When the learners enter the class the first day, the laboratory will be ready for production. The following procedure is recommended for completing the task:

(1) Teacher introduces the product and production scheme to the class.

(2) Teacher demonstrates each production operation to entire class, emphasizing safety, proper use of equipment and quality control.

(3) Learners select or are assigned to work stations which include quality control stations.

(4) Teacher supervises learners' activities at each station.

(5) Production begins.

(6) Learners rotate jobs to gain various experiences.

2. Custom prototype construction experience - The mass production experience is followed by an individual developmental experience which is designed to demonstrate the steps leading to a mass-produced item by way of product design and development, market research, design evaluation and improvement, model development, selection of materials and prototype construction.

a. Selecting the product for study–following is a list of topics of possible student interest from which activities might be selected. These categories of man-made products, which partially incorporate the commonalities of society's activities involving product materials, processes and production are:

(1) Recreational equipment (musical instruments, sports equipment and games).
(2) Tools and machines.
(3) Transportation devices (land, water, air and space).
(4) Household goods (furniture, appliances and furnishings).
(5) Wearing apparel (clothing and jewelry).
(6) Structures (residential, commercial, bridges, dams, tunnels and highways).

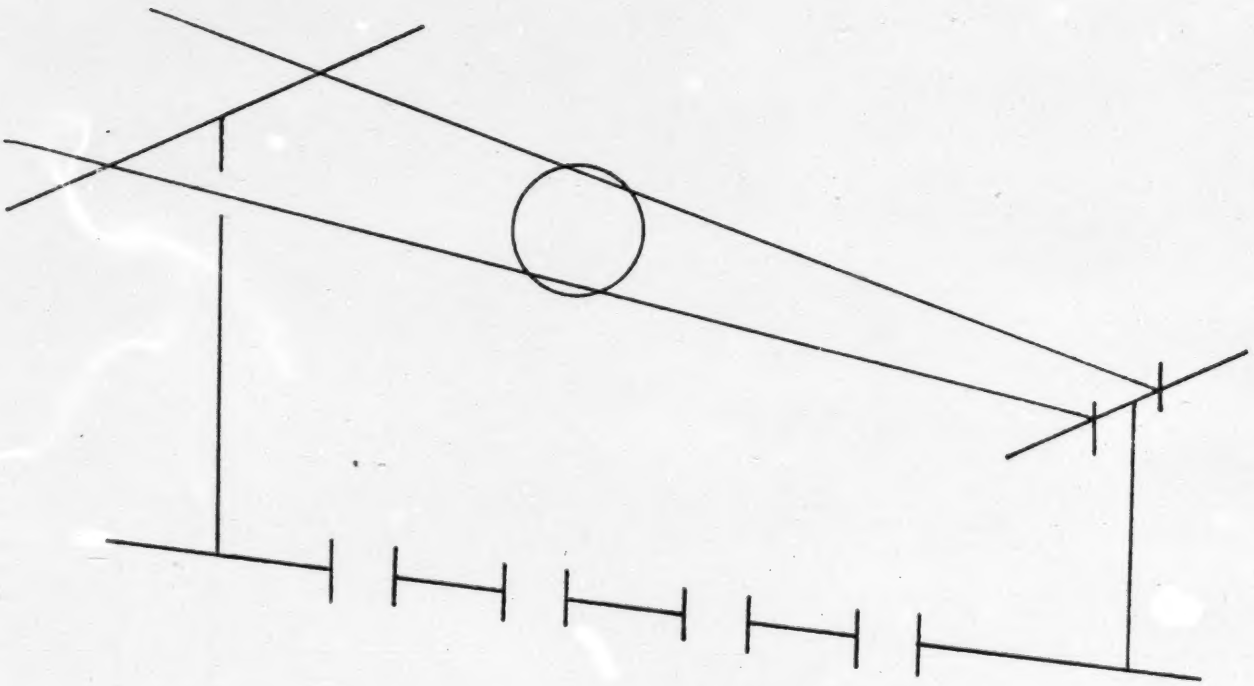
b. Product design and development-for the purpose of this model the writers have assumed that the class has identified a *"gravitational game"* as their selected product activity within the area of recreational equipment--games. The product is analyzed and the teacher presents the class with a simple sketch and verbal description illustrating the basic function of the game (see illustration). During the product design and development stage the teacher must develop learner concepts of product materials and processes as well as the skill necessary to produce a working sketch of the product. It is recommended that a segment of each class meeting be set aside for learner activity in sketching fundamentals with outside assignments made for experience using two and three-dimensional sketches.

(1) *Common product materials*–the class will discuss major groupings of materials listed on the content outline under *"product materials"*. This discussion will encompass the structure and characteristics of these materials and then identify potential product materials which can perform the desired function.

(2) *Common processes*–using a minimum of three different basic materials as listed in the content outline, i.e., forest products, metals, plastics, textiles, and ceramics, the teacher will demonstrate the seven basic processes identified on the content outline. Examples:

(a) *Casting*

–pouring premixed slip into a plaster mold
–pouring molten metal into a permanent metal mold (sinker mold)
–placing concrete into a wooden mold
–pouring mixed resin into a metal jello mold
–pouring mixed plaster into a cardboard container



GRAVITATIONAL GAME

This game has two (2) rods pivoted at one end - free and adjustable at the other end. The rods are supported above the score base and are so positioned that the free end is higher than the pivoted end.

The purpose of the game is to obtain maximum ball travel along the length of the rod. The longer the travel toward the free end prior to dropping the greater the score.

(b) *Parting*

–shearing thin gage metal with handsnips, chisel or squaring shears
–sawing wood with or across the grain
–melting polystyrene plastic with a resistance wire
–shearing glass with a glass cutter
–shearing cloth with a scissors

(c) *Machining*

–drilling a hole in a cinderblock using a carbide drill
–turning wood on a lathe
–routing a bead on a piece of wood
–griding tool steel and mild steel
–file acrylic plastic to shape
–threading mild steel bar using a threading die

(d) *Pressure forming*

–bending thin gage metal using bar folder, brake or slip roll
–spinning thin gage metal on spinning lathe
–blowing glass tubing to a bubble shape
–vacuum form acrylic plastic
–compress powder metal using punch and die
–forging cold or hot metal by hammering
–stamping and tooling oak-tanned leather
–steam bend thin wood to a curved shape

(e) *Joining*

–rivet two pieces of sheet metal using a rivet or pop rivet
–fasten wood with nails, screws or bolts
–cement two pieces of leather using rubber cement
–joining two bricks using mortar
–fusing two pieces of acrylic plastic with ethylene dichloride
–fusing pewter with heat
–sweat solder copper tubing to fitting
–knotting two pieces of string

(f) *Treating*

–case harden a piece of low carbon steel
–impregnate a piece of wood with preservative (wood life)
–spraying cloth with a water proofing material
–impregnate glass cloth with resin
–firing a piece of green ware to remove the chemically combined water
–work harden copper and then anneal it

(g) *Finishing*

–tin a soldering copper

–coat a wood or metal surface with paint

–frost the surface of a piece of clear acrylic plastic with abrasive paper

–wax a piece of leather

–spray starch and iron a piece of cloth

–electroplate a piece of steel with copper

c. Producing the protytypes–at this point the teacher will have explained and demonstrated the structure and characteristics of the product materials and process concepts as listed in the content outline. The learner will also have had the opportunity to develop the skills needed to individually design a product representing the solution to the problem: Gravitational Game. The teacher helps learners so they complete the working sketch of their solution and works with them individually as they proceed to make their prototype. It is felt the teacher would need the least guidance from a planned course in this part of the teacher-learner activity for most industrial arts programs are strong in this area.

d. Additional units to be covered as time allows:

(1) Environmental effects

(2) History of production (evolution)

(3) Occupational information

(4) Organization for management

(5) Sales and servicing

EVALUATION

Every planned course should develop procedures for evaluation which are based on its philosophy and objectives. Accordingly, the extent to which it is meeting the needs of the students enrolled in it should be ascertained. These evaluative criteria may be viewed as indexes of accomplishment where the quality and nature of the work done in a planned course are related to the philosophy and objectives of the course and the needs of the youth who are being served by the course. It is always best to explore in an atmosphere of success. Therefore, it is in the best interest of all students to have an experience of success in completing a planned course in industrial arts education.

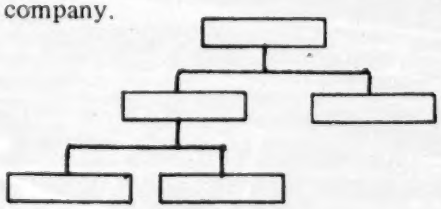
The following are evaluative criteria which can be used with the foregoing suggested models of instructional activity.

VISUAL COMMUNICATIONS

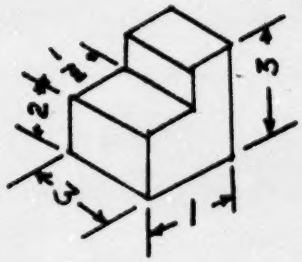
1. List and describe, either in writing or by a sketch, basic methods of reproducing (printed) materials.
2. Organize a sequential time line for the following basic operations used in producing a magazine.
   a. Artwork
   b. Image transfer
   c. Image assembly
   d. Image carrier preparation
   e. Finishing procedures
3. From the following list, identify four occupations that relate to the visual communications industry.
   a. Draftsman
   b. Welder
   c. Photographer
   d. Pressman
   e. Lithographer
   f. Molder
   g. Electrician
   h. Platemaker
4. Produce a free-hand sketch of the same object using only a piece of graph paper, pencil and eraser.
5. Describe the difference between artistic and technical drawing.

INDUSTRIAL MATERIALS

1. Given a list of jobs, complete the following organizational flow chart for the hierarchy of jobs in the manufacturing company.



2. Explain the two differences between custom and mass production of goods.
3. Using the styrofoam and tools provided, make a model from the following drawing.



4. Develop a flow chart showing six required jobs or processes and flow of materials in the production of a gravity game.

POWER

1. Using the power system selected, list and define three parts of the power system cycle.
   a.
   b.
   c.
2. List four applications of the power system selected.
   a.
   b.
   c.
   d.
3. Define the working fluid in which the energy change takes place for the power system selected.
4. From the following list of occupational areas, identify and describe four occupations relating to the power industry.
   a. Automotive
   b. Aero-space
   c. Nuclear
   d. Submarine
   e. Hydroelectric
   f. Construction
   g. Mining
   h. Oceanography
   i. Manufacturing